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(71) Applicant: SOCIETA' PNEUMATICI PIRELLI S.p.A.
Piazzale Cadorna 5
I-20123 Milano(IT)

(72) Inventor: Semin, Fikret
Piazza Napoli, 38
Milan(IT)

(72) Inventor: Guermandi, Romano
Via Monte San Genesio N. 27
Milan(IT)

(72) Inventor: Cucco, Gian Carlo
Via Galvani, 1
Villa Cortese Milan(IT)

(74) Representative: Mariani, Giorgio, Dr. et al,
INDUSTRIE PIRELLI S.p.A. Direzione Brevetti Piazzale
Cadorna, 5
I-20123 Milano(IT)

(54) Directional tyres for automobiles.

(57) The invention concerns a tread-pattern of the directional type, for automobile tyres that are intended for high-powered vehicles and for exacting conditions of usage - because of the great accelerations used and the very high speeds reached during driving, even when cornering. The tread-pattern is constituted by a plurality of small blocks (5) having a substantially rhomboidal form, disposed in at least six circumferential rows and separated, one from the other, by straight circumferential grooves (1) and by oblique transversal grooves (2,3,4), with the grooves of the two ~~adjacent~~ innermost rows, disposed astride of the mid-plane, being inclined in the contrary sense in each row - both, with respect to the next row, as well as with respect to the oblique grooves of the other remaining rows disposed in the same mid-plane as the tread-band.

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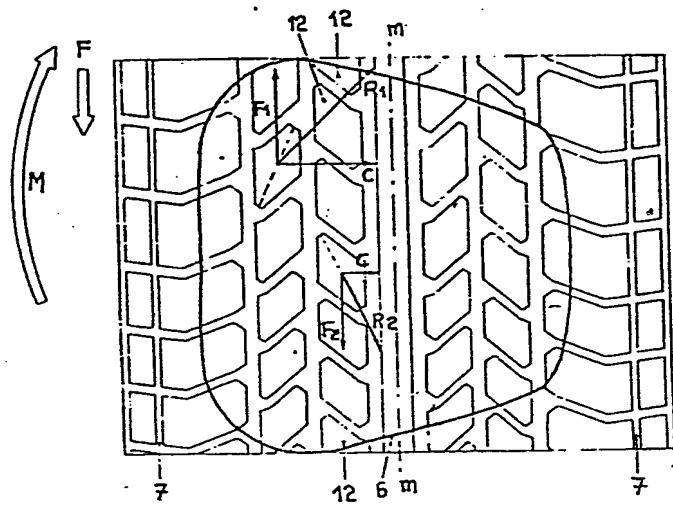


FIG 2

DIRECTIONAL TYRES FOR AUTOMOBILESSpecification

5 The present invention regards automobile tyres and in particular, it concerns the raised design - better known as the tread-pattern, with which the outer surface portion that comes into ground-contact, is provided.

10 As already known, automobile tyres present their crown portion, which extends axially from one sidewall to the next, as being provided with a thick elastomer layer - known as a tread-band, having variously disposed grooves made in it, in such a way as to subdivide said band into ribs and/or blocks
15 that are separated one from the other by said grooves. Said ribs and said blocks are generally also provided with sipes i.e. with narrow cuts - directed radially from the surface of the tread-band towards the tyre interior, which have a variable depth and which can also open-out upon the sides of the
20 ribs and the blocks.

In fact, the whole assembly of grooves and sipes, constitutes the tread-pattern - which forms a characteristic and distinctive element of the tyre and which, above all, is variable
25 depending upon the type of usage to which the tyre is subjected.

For example, those tyres that require good non-skidding endowments - since they are destined for being used on snow
30 covered and miry ground or on rugged terrain, present tread-patterns that are heavily 'blocked' with wide and deep cut-outs and grooves and by rather massive blocks; while the tyres that are usually destined for use on roads in a good

1 state, are normally distinguishable by their big circumferen-
tial grooves, usually having a zig-zag configuration, from
which their branch out very narrow transversal sipes which,
at times, extend till the entire rib-width, with generally
5 having a tortuous configuration. In fact, the main purpose
of these tread-patterns is to break the liquid film that is
created between tyre and road, under wet road conditions,
with thus minimizing the negative 'aquaplane phenomena' and
moreover, with guaranteeing a high degree of steerage capaci-
10 ty, driving stability and road holding behaviour.

For those tyres destined for equipping the sports-class type
of cars - i.e. the tyres, destined for usage on roads that
are generally in a good state, but which have to undergo
15 critical exercise conditions owing to the great accelerations
and high speeds involved, even in cornering, it has recently
been found quite convenient to employ tread-patterns consti-
tuted by a plurality of blocks disposed in circumferential
rows that are separated one from the other by circumferential
20 rectilinear grooves and by obliquely disposed transversal
grooves, in such a way that the blocks have a substantially
rhomboidal form - i.e. the opposite sides substantially
parallel to each other, and the two consecutive sides, of
substantially different lengths, being inclined one with
25 respect to other, at an angle having a value diverse to 90°.

In the old tread-patterns, the transversal grooves that -
along with the longitudinal grooves defined the blocks, had
an inclination which was contrary (with respect to the cir-
30 cumferential direction of the tyre) to that of the adjacent
rows. Successively, these grooves were disposed so as to all
be oriented in the same sense, with respect to said circum-
ferential direction. Nevertheless, in the more recent tyres,

1 it proved to be more convenient to dispose said transversal
grooves in a herring-bone pattern - i.e. inclined in such a
manner as to have them all converging in the same direction
towards the equatorial-plane of the tyre. Hence, with having
5 the inclination of these grooves in the opposite sense to one
another, as regards the tyre's circumferential direction, in
the two tread-band portions flanking said equatorial-plane.

Hence, a series of changes have been made in the tread-
10 pattern - with finally realizing the so-called "directional"
type of tread - i.e. a pattern substantially symmetrical with
respect to the equatorial plane, but asymmetrical with res-
pect to any whatsoever axial plane, for which reason the
tyre's contact area upon the ground changes, on inverting the
15 sense of rotation of the wheel.

Therefore, said tyres present a preferential sense of rota-
tion, that is usually indicated by stamping a special refer-
ence mark - an arrow, for example, on the tyre's sidewall.

20 Owing to this preferential direction of rotation, these tyres
can give a positive or negative performance - in terms of
their directional stability and their resistance to the
aquaplane phenomena, depending upon their direction of rota-
25 tion.

Apart from this, owing to the increased demands for a better
performance from this type of tyres and this type of cars,
the traditional tread-patterns have also shown to be strongly
30 sensitive to any sort of exercise that only involves extreme
conditions of usage and which just involves those blocks
disposed on one side of the equatorial plane and just a
certain portion of each block - with compromising, in said

1 manner, a uniform wearing-out and hence, the service life of
the tyre itself and its reliable performance throughout the
passage of time.

5 The Applicant has now invented a new way of designing and
disposing said blocks, that has revealed to be especially
efficacious in obstaculating this type of wearing out from
taking place, not to mention its developing, and in finding a
remedy for the drawbacks reported by the known tread pat-
10 terns.

Hence, the aim of the present patent is a new tread pattern -
of the directional type, for tyres that are intended to be
utilized on high-powered cars which are capable of running at
15 very high speeds.

Therefore, what forms the object of the present patent of
invention is a tyre for vehicle-wheels, comprising a substan-
tially toroidal carcass, and a tread-band disposed in the
20 crown zone (corona) of said carcass and destined for coming
into ground-contact during tyre running, said tread-band
presenting a plurality of sipes which define a raised pattern
that is apt for improving the driving characteristics and the
road-holding behaviour of the tyre under any whatsoever
25 driving conditions, said tread pattern comprising a plurality
of circumferential and transversal grooves that divide said
tread-band symmetrically, with respect to the equatorial
plane of said tyre, into a plurality of blocks disposed in at
least six circumferential adjacent rows, said tyre being
30 characterized by the fact that the transversal grooves which,
delimit, one from the other, the blocks of the two axially
innermost rows - situated on opposite sides of said equatori-
al plane, are inclined in the contrary sense (with respect to

1 the circumferential direction of the tyre) in each row with
respect to the other row, and with respect to the sense of
the transversal grooves that delimit the blocks of the re-
maining axially outermost rows.

5
In a first form of realization of the invention, said tread-
pattern comprises six circumferential rows of blocks, with
the tread-band portion occupied by each row of axially outer
blocks being substantially as wide as the flanking tread-band
10 portion occupied by the adjacent pair of block-rows. As an
alternative, said pattern could also comprise a continuous
circumferential rib, disposed astride of the tyre's equatori-
al plane; or else, two continuous circumferential ribs
disposed axially outwardly to the two inner circumferential
15 rows. Preferably, the said ribs have a rectilinear layout,
but they could also be designed to have a zig-zag configura-
tion.

According to another embodiment, when said tread-pattern
20 comprises an odd number of circumferential block-rows, the
blocks of the central row are disposed astride the tyre's
mid-plane and separated one from the other by transversal
grooves that present - at their inlets, the same direction,
for the grooves, as that of the adjacent row of blocks.

25
As far as concern the blocks themselves, it is feasible for
the blocks of at least one pair of corresponding circumferen-
tial rows to have a rhomboidal surface, and/or for the blocks
of at least one pair of the axially inner rows to have a
30 rhombical surface.

For preference, the angle of inclination of the transversal
grooves, with respect to the circumferential direction of the

1 tyre, should be comprised between 40° and 75° ; moreover,
said angle of inclination of the transversal grooves, should
diminish on passing from the axially outermost row to the
axially inner row.

5

For preference, the transversal grooves are all symmetrically
inclined with respect to the equatorial plane of the tyre and
moreover, according to a further form of embodiment of the
said tread-pattern, said transversal grooves all face one
10 another.

The present invention will now be better understood through
the aid of the following description and the attached figures
- that are given solely by way of non-limiting example,
15 whereby:

FIG. 1 shows the tread-pattern, according to the inven-
tion, in a first form of realization;

20 FIG. 2 illustrates the tread-pattern, according to the
invention, in the preferred form of embodiment;

FIGS. 3 to 5 show further variations of realization for
the tread pattern of the invention;

25

FIG. 6 shows the same tread pattern of fig. 2, rotated to
 180° .

Fig. 1 illustrates a limited circumferential portion of the
30 tread pattern, with of course it being clearly understood
that said portion will be continually and substantially
identically repeated throughout the entire perimetral layout
of the tyre.

1 The said pattern presents five circumferential rectilinear
grooves 1 and a plurality of transversal grooves 2, 3 and 4,
that divide the tread-band into a plurality of blocks 5,
disposed in six adjacent circumferential rows. In accordance
5 with the invention, the transversal grooves 4, relative to
the two axially innermost rows that are disposed on opposite
sides with respect to the equatorial plane, the tyre mid-
plane m-m, are inclined in the contrary sense, with respect
to the said plane,- both with respect to each other as well
10 as with respect to the inclination of the transversal grooves
2 and 3 relative to the remaining axially outermost rows.

Thus, the design results as being symmetrical with respect to
the mid-plane, but non-symmetrical with respect to any what-
15 soever axial plane. Hence, it is evident that the tyre is of
the already described 'directional' type, that presents a
preferential direction of rotation; so much so that even the
tyre of the invention preferably carries indications on its
sidewalls for the showing the mounting direction that is
20 preferred - or even binding. It has to be specified here
that said symmetry has not to be taken in the strictly geo-
metrical sense, since, for the purpose of the invention, even
those patterns have been considered to be symmetrical -
wherein the inclination of the transversal grooves, in pairs
25 of corresponding rows of blocks, differs from row to row,
although still maintaining the same direction of inclination.

In particular, supposing one were to observe the tyre from
the front, with determining with F (fig. 1) the sense of
30 rolling of the pattern, the tyre of the invention should
preferably be mounted onto the vehicle, as seen in fig. 1, on
the driving-wheels, rotated to 180° on the driven-wheels.

1 The assembly of all the grooves, is drawn in such a way as to
give origin to rhomboidal-shaped blocks - i.e. defined by
pairs of substantially parallel facing sides and by the
existence of an angle, with a value diverse from 90° , between
5 two consecutive sides.

It must also be specified that concerning said rhomboidal
form, this regards the more general global aspect of the
blocks which moreover, present all those contrivances - such
10 as, for example, the cutting-off of the sharp edges - which
are necessary precautions for eliminating the risky phenomenon
of priming too early a wear-and-tear and ripping and
chipping of the said edges.

15 The dimensions of said blocks can of course vary along the
perimetral layout of the tyre, particularly with the purpose
of enhancing the noiseless condition of the tyre - by preventing
any such bothersome phenomena as having an acoustic
resonance.

20

The inclination of the transversal grooves of the block-rows,
which forms the main object of the present invention, can be
identical in all of the rows, but in the diverse rows it can
also present the angles a, b, c as being slightly different
25 one from the another. Preferably (as shown in the figures)
said angles diminish in their values - with respect to the
equatorial plane of the tyre, as they pass from the axially
outer rows to the axially inner ones.

30 The value of the angle of inclination of said grooves, is
preferably comprised between 40° and 75° , with the angular
variation, between the angles of inclination in any two

1 adjacent rows, not exceeding 20°.

Moreover, all the transversal grooves result as facing one
another - for the purpose of favouring the flow of water and
5 for improving the resistance to the aquaplane phenomena.

In this version, the blocks on the tyre shoulder are very
massive, with having their transversal dimensions substan-
tially equal to the tread portion on either side, wherein
10 there are comprised the furthest two circumferential rows of
the axially inner blocks.

Fig. 2 shows the preferred form of realization of the tyre of
the invention; the essential characteristic of the reciprocal
15 inclination of the transversal grooves is evidently present
even in this version - where the angles a, b c respectively,
have the values of 68°, 50° and 50°, and wherein there never-
theless appear certain variations of realization that have
allowed to perfect said tyre even better.

20 In the first place the circumferential grooves are now eight
in number - with respect to the five-grooves version pre-
viously illustrated. In fact, in-between the two axially
innermost rows, there has now been realized a narrow recti-
25 lineal circumferential rib 6, disposed astride of the mid-
plane m-m, which has originated a new circumferential groove.
Moreover, a further circumferential groove 7 has been made in
each row of the axially outer blocks.

30 Besides this, even the form itself, of the blocks in the
outer rows, has been modified by varying the trajectory of
the respective transversal grooves.

1 These grooves now result as being comprised by a broken-line
whose constituting-sections have diverse slants. The angle-
zone substantially corresponds with the outer edge of the
tyre's contact area. The axially inner groove portion main-
5 tains the inclination pre-established by the invention, while
the axially outer groove portion may have the same sense of
direction - but with a diverse inclination, or else, it may
even have a contrary sense (as is illustrated in the figures)
with respect to the axial direction. Finally, it may also be
10 inclined in a substantially axial direction - as will be
explained further on in this text.

The form of the axially outer blocks is now seen as two
diverse axially adjacent joined-together rhomboidal blocks,
15 substantially having the same surface area, whereby the
axially outer block results as being further sub-divided, by
the axially outermost circumferential groove 7, into two
almost equal blocks.

20 The blocks of the axially inner rows have been slightly
modified by acquiring a substantially rhombical form. Said
difference, with respect to the previous substantially rhom-
boidal form, being determined by the fact that the blocks'
sides now all have more or less the same dimensions.

25 In this design, the transversal grooves have also been stag-
gered to one another in each row, for the purpose of improv-
ing the noiselessness in the vehicle during tyre running.

30 Let us now pass on to fig. 3. Said figure illustrates a
further variation of realization in the design of the inven-
tion, which differs from that of fig. 2 owing substantially
to the fact that the axially outermost groove 7 has been

1 brought into correspondence with the previously-mentioned
angle of the broken-line, with thus creating eight circum-
ferential rows of blocks having substantially equal surfaces.
The six axially inner rows are those which correspond to the
5 tyre's contact area - i.e. the rows which, during straight-
away driving, usually come into contact with the road;
whereas the two axially outermost rows - disposed in the zone
where the tread-band curves towards the tyre shoulders, only
come occasionally into ground-contact, in particular when the
10 vehicle is cornering.

The transversal grooves of the axially inner rows, are all
inclined with respect to the tyre's circumferential direc-
tion; whereas the grooves relative to the two axially outer-
15 most rows, are perpendicular to said direction - i.e. they
are parallel to the axis of the tyre.

Evidently, as far as concern the rows of axially outer
blocks, since the transversal grooves are substantially
20 disposed at 90° with respect to the circumferential direction
of the tyre, these blocks acquire a square or rectangular
form.

Besides this, the continuous circumferential rib, disposed on
25 the tyre's mid-plane, has been sub-divided into a row of
circumferential blocks 8, one separated from the other by
transversal grooves which present - at the two inlets facing
towards the two axially innermost rows of circumferential
blocks, the same inclination as that of the transversal
30 grooves dividing these latter.

Fig. 4 illustrates a further variation in realization for the
design of the invention that, substantially speaking, is so

1 obviously self-evident as not to require any complicated explanations, nor any particular reference numerals either.

5 In particular, said design results as being characterized by the presence of two rectilinear, continuous circumferential ribs 9, that separate the two axially innermost rows from the remaining rows of blocks. After the insertion of these two ribs, the tyre's shoulder zone results as being modified - through the elimination of the two axially outermost rows of
10 narrow, quasi-rectangular blocks, as seen illustrated in the above-said fig. 2.

To end with, as illustrated in fig. 5, the continuous circumferential ribs (previously indicated in figs. 2 and 4) could
15 also have a zig-zag configuration (just as that of rib 10) instead of a rectilinear one. In said instance, it will result as being preferable to also modify the profile of the blocks on the side facing said ribs, in such a way as to regularize the layout of the width of the corresponding
20 circumferential groove 11.

However, from all the cited figures, what appears as being quite clear is the main characteristic of the invention - as represented by the condition that, at least in the contact
25 area, and with respect to the equatorial mid-plane, the transversal grooves of the two axially innermost rows of blocks are inclined in the contrary sense to each other, as well as with respect to the inclination of the transversal grooves in the remaining rows of the corresponding tread
30 portion.

As it has already been stated, with reference to the tyres made with 'blocks', as those destined for being used on

1 vehicles endowed with an exceptionally high horsepower and
speed, and even those tyres wherein the transversal grooves
are all inclined, in the same sense, or else in the contrary
sense, in the two tread portions disposed on opposite sides
5 with respect to the equatorial plane, these tyres show, under
critical conditions of exercise, an uneven type of wearing-
out that is initiated only on the blocks of one part of the
tyre and just in a surface position of each block; said
wearing-out negatively and drastically influences the ser-
vice-life of the tyre.
10

With the tyre of the invention, the Applicant has discovered
that said uneven wearing-out is substantially eliminated -
which fact hence, guarantees the tyre life till the entire
15 tread becomes worn-out.

For understanding how this improvement was probably attain-
ed, one can consider fig. 2 - with supposing that the tyre is
mounted on a driving wheel, the left-hand sidewall being the
20 outer one of the vehicle, and proceeding in the forwards
direction M (in the contact area) along a curvilinear path
that is inclined towards the angle on the upper-right of the
figure-table and viewed from below - i.e. with the surface of
the blocks lying in the contact area.
25

In other words, the lower side of the design represents the
tyre's entry into the contact area, and the upper side re-
presents the tyre's exit from the same area.

30 We should also suppose that the tyre is subjected to a
torque. Under said running conditions, the contact area
substantially results as being shifted to the axially outer
portion of the tyre - and the blocks, in the contact area are

1 subjected to a longitudinal reaction F1, and to the centripetal force C that acts upon the vehicle, these latter both combining together to produce R1 as a resultant force.

5 Obviously, and in order to have low wearing-out values for the blocks, the latter should be oriented so as to have their greater diagonal substantially according to R1. This is the reason why the herring-bone type of disposition for the blocks is used in the more recent known tyres.

10

Nevertheless, said type of disposition has proved to have certain drawbacks. Above all, when the motive couple is lacking, or even if a braking couple is applied, the longitudinal reaction F1 on the block either annuls or inverts the
15 direction, with originating the reaction F2; while the centripetal force C diminishes in value but maintains its direction, so much so that the direction of the resultant force R2 sensibly changes - with thus resulting as being disposed substantially according to the lesser diagonal of
20 the said blocks.

In this direction, the block presents a low rigidity and hence, it wears out very rapidly as, for that matter, road-performance tests have shown.

25

Since the blocks of the known tyres are all disposed to have the same orientation with respect to the travelling direction of the tyre, their actual resistance capacity is substantially identical - for which reason they also wear out more or
30 less together.

Moreover, the direction of the grooves - that converge towards the centre of the tread, is such as to accumulate the

1 water that is present on the road, in the front part and
centre of the tyre - with this fact hence rendering the tyre
very sensible to the aquaplane phenomena.

5 There are multiple advantages to be had with the tyre of the
invention - but, in a particular way, it has surprising
demonstrated its ability to overcome the above-said draw-
backs, thanks precisely to the axially innermost row of
blocks 12 that is oriented in the contrary sense (see fig.
10 2).

In fact, with regard to the wearing-out - under riding condi-
tions with the vehicle accelerating speed when cornering, it
may be thought that the block 12, oriented in the direction
15 of lesser resistance, would deteriorate quite rapidly. On
the other hand, this lesser resistance loads the greater part
of its frictional force upon the axially outermost rows, so
much so that the block 12 demonstrates to be efficaciously
protected against any such precocious and uneven wearing-out.

20 Vice-versa, when the acceleration is modest or completely
lacking, then the blocks of the said axially innermost row
result as being oriented according to the direction of maximum
resistance - so much so that it is these blocks now, that
25 absorb the maximum part of the frictional force loaded upon
the tread pattern, with efficaciously preserving the blocks
of the outermost rows from any uneven or precocious wearing
out.

30 Given that this last mentioned condition of exercise is
considerably less heavy when compared to the previous one, in
practice a single row of blocks in each mid-plane of the
tread-band can absorb the maximum force that is exercised on

1 the tread - whereas at least two rows of blocks are necessary
under the previous 'extreme conditions' of tyre running.

5 Finally, as far as regards the aquaplane, the inclination of
the grooves of the above-said row of axially innermost
blocks, is such as to push the water collected (when travel -
ing on the road) towards the tyre shoulders, so much so that
any accumulation of water under the central tread-portion is
10 impeded; while the combined action of the transversal
grooves, having a contrasting slant, is such as to push the
water along the circumferential grooves, resulting in a
beneficial effect with respect to 'road-gripping' capacity of
the tyre of the invention, when travelling on wet roads.

15 Said benefit results as being further accentuated in the
presence of the rib, or of the continuous circumferential
ribs - that create a physical separation between the two flow
currents of water.

20 If we now consider the driven-wheels, a motive couple can
never result as being applied on these - so that the longi-
tudinal reaction F3 is always directed in the opposite sense
with respect to F1, at a parity of the direction of movement.
This situation is illustrated in fig. 6, where the same
25 reference numerals N and F are maintained with regard to the
advancing direction and the path of the vehicle.

It is evident, on considering the just specified orientation
of F3, that the optimal situation will be had when the rows
30 of the axially outer blocks present their transversal grooves
as being inclined in the contrary sense, with respect to the
orientation they have in fig. 2. This optimal orientation is
obtained, without any problem, by simply mounting the tyre

1 rotated to 180° on the driven-wheels - with respect to the
mounting effected on the driving-wheels, as can immediately
be verified on comparing fig. 2 and said fig. 6 - which
moreover, is nothing but the previous fig. 2 rotated in such
5 a way that the lower part now becomes the upper part and
vice-versa.

Moreover, it must be understood that the present description
has solely been given by way of non-limiting example, for
10 which reason what have also to be considered as being com-
prised within the ambit of the present invention are also all
those modifications and alternative variations that have not
been expressly described - but which are easily deducible
from the inventive idea by any technician of the field.

15

20

25

30

1 WHAT IS CLAIMED:

5 1. Tyre, for vehicle wheels, comprising a substantially toroidal carcass and a tread-band disposed in the crown of said carcass and destined for coming into ground-contact during tyre running, said tread-band presenting a plurality of sipes which define a raised pattern that is apt for improving the driving characteristics and the road-holding behaviour of said tyre under any whatsoever driving conditions, said pattern comprising a plurality of circumferential (1) and transversal grooves (2,3,4) that divide said tread-band symmetrically with respect to the equatorial plane of said tyre, into a plurality of blocks (5) disposed in at least six circumferential, adjacent rows, said tyre being characterized by the fact that the transversal grooves (2,3,4), which delimit, one from the other, the blocks of the two axially innermost rows situated on opposite sides of said equatorial plane, are inclined in the contrary sense (with respect to the circumferential direction of the tyre) in each row with respect to the other row and with respect to the sense of the transversal grooves that delimit the remaining axially outermost rows.

25 2. Tyre, according to Claim 1, characterized by the fact that said pattern comprises six circumferential rows of blocks, the tread portion occupied by each row of axially outer blocks, being substantially as wide as the adjacent portion of tread occupied by the adjacent pair of rows of blocks.

30

3. Tyre, according to Claim 1, characterized by the fact that said pattern presents eight circumferential rows of blocks.

1 4. Tyre, according to Claim 1, characterized by the fact that the blocks, of at least one pair of corresponding circumferential rows, have a substantially rhomboidal form.

5. Tyre, according to Claim 1, characterized by the fact that the blocks, of at least one pair of corresponding axially inner rows, have a substantially rhombical form.

0 6. Tyre, according to Claim 1, characterized by the fact that the angle of inclination (a,b,c) of the transversal grooves, with respect to the circumferential direction of the tyre, is comprised between 40° and 75°.

5 7. Tyre, according to Claim 6, characterized by the fact that said angle of inclination of the transversal grooves, diminishes in proceeding axially from outside towards inside.

0 8. Tyre, according to Claim 1, characterized by the fact that the transversal grooves (2) which delimit the blocks in the axially outermost row, are directed in the axial sense.

5 9. Tyre, according to Claim 1, characterized by the fact that the transversal grooves of the axially outermost rows, have a broken-line trajectory, the axially innermost groove portion being inclined, with respect to the equatorial plane of the tyre, in the same sense as the grooves of the adjacent row.

10 10. Tyre, according to Claim 1, characterized by the fact that the transversal grooves of the corresponding rows, on opposite sides of the tyre's equatorial plane, are inclined symmetrically with respect to said plane.

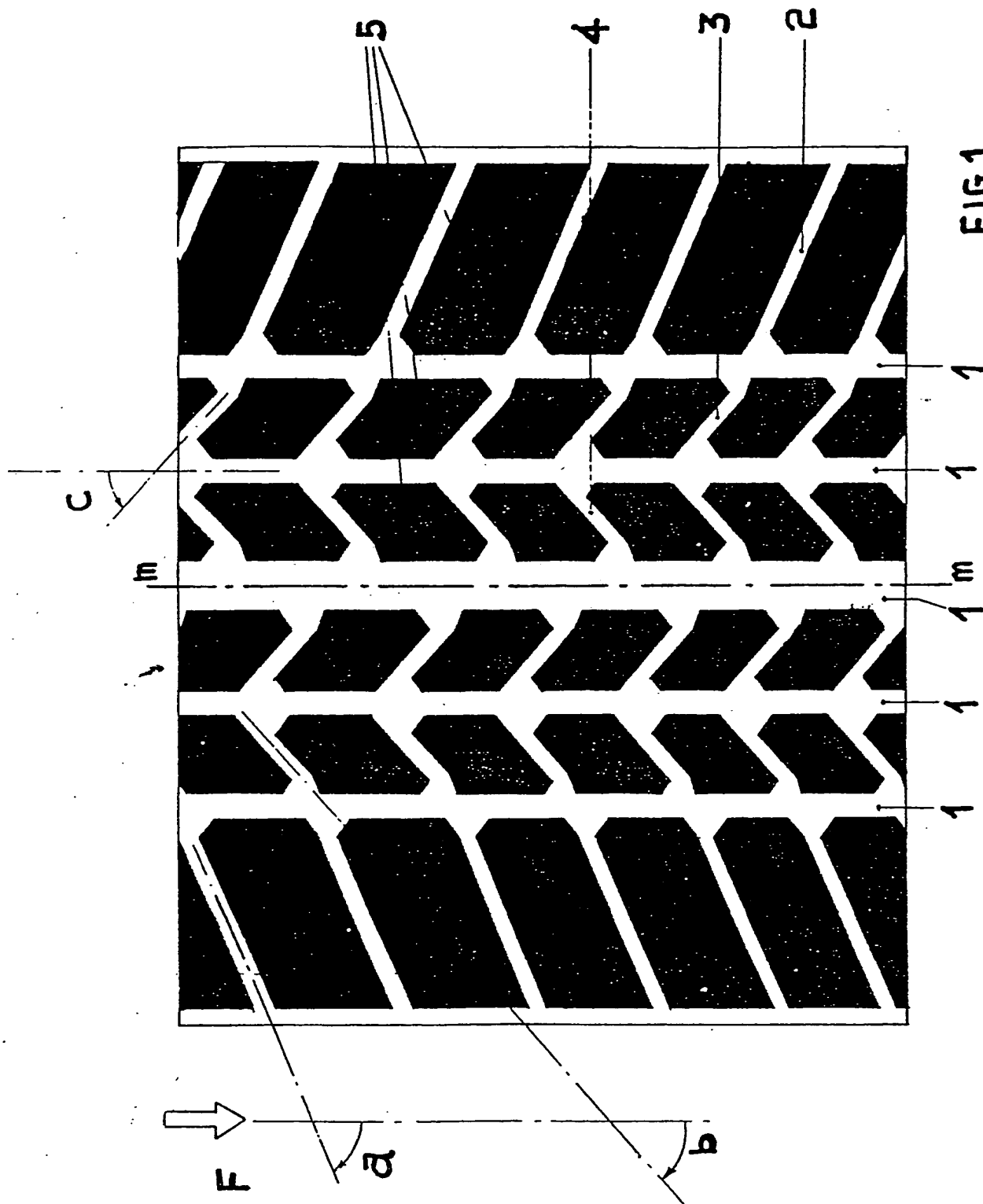


FIG 1

FIG 2

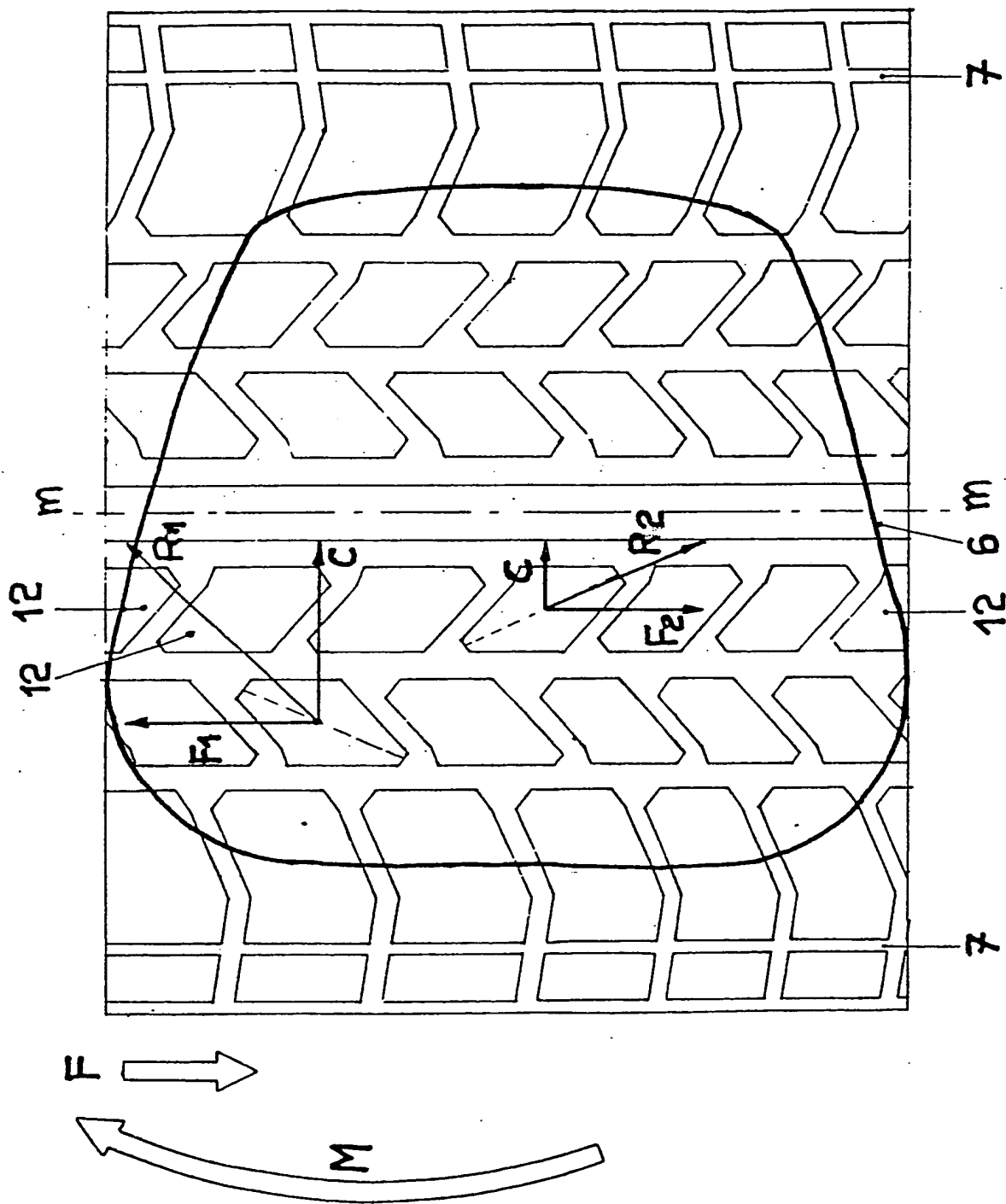
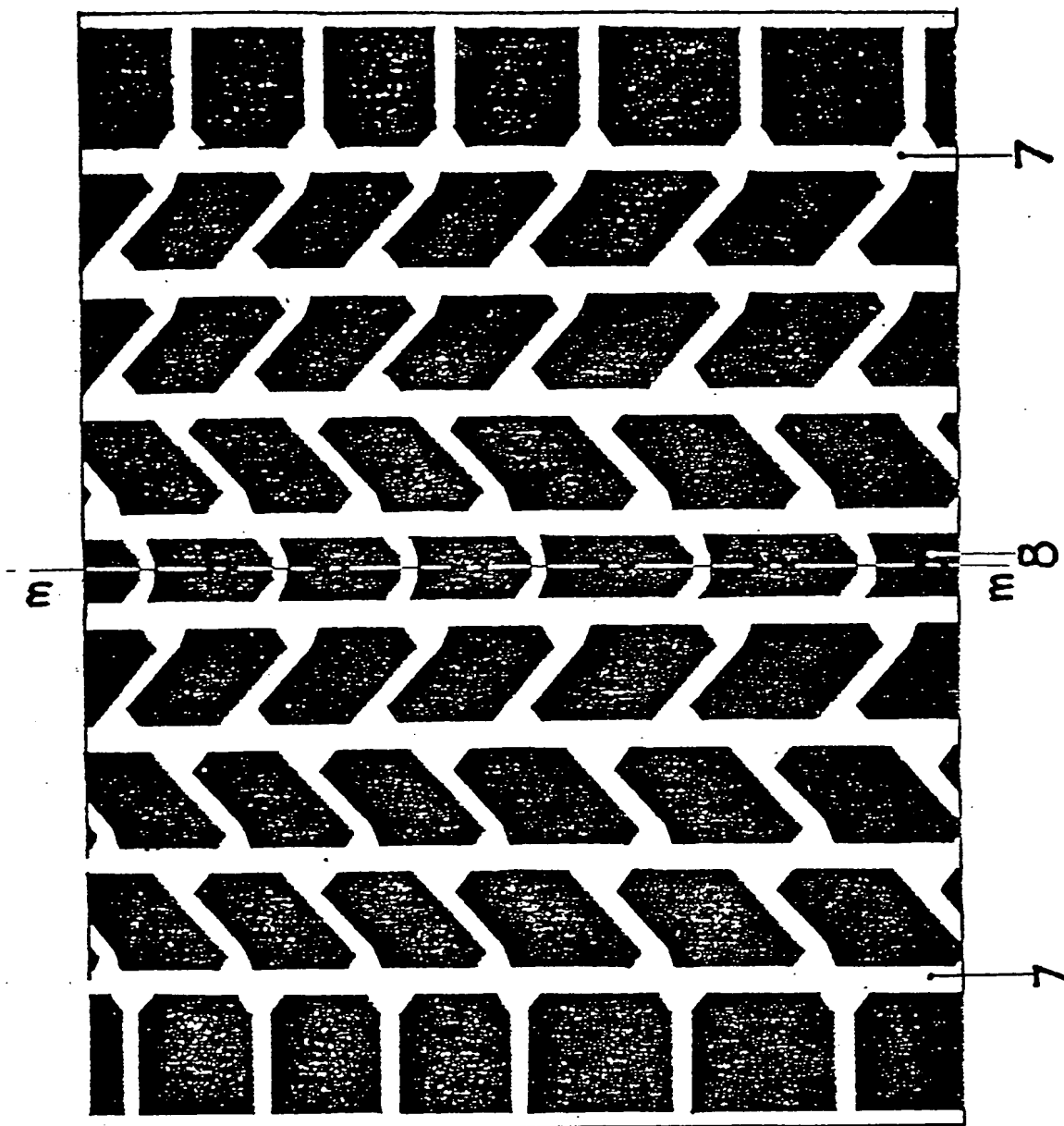


FIG 3

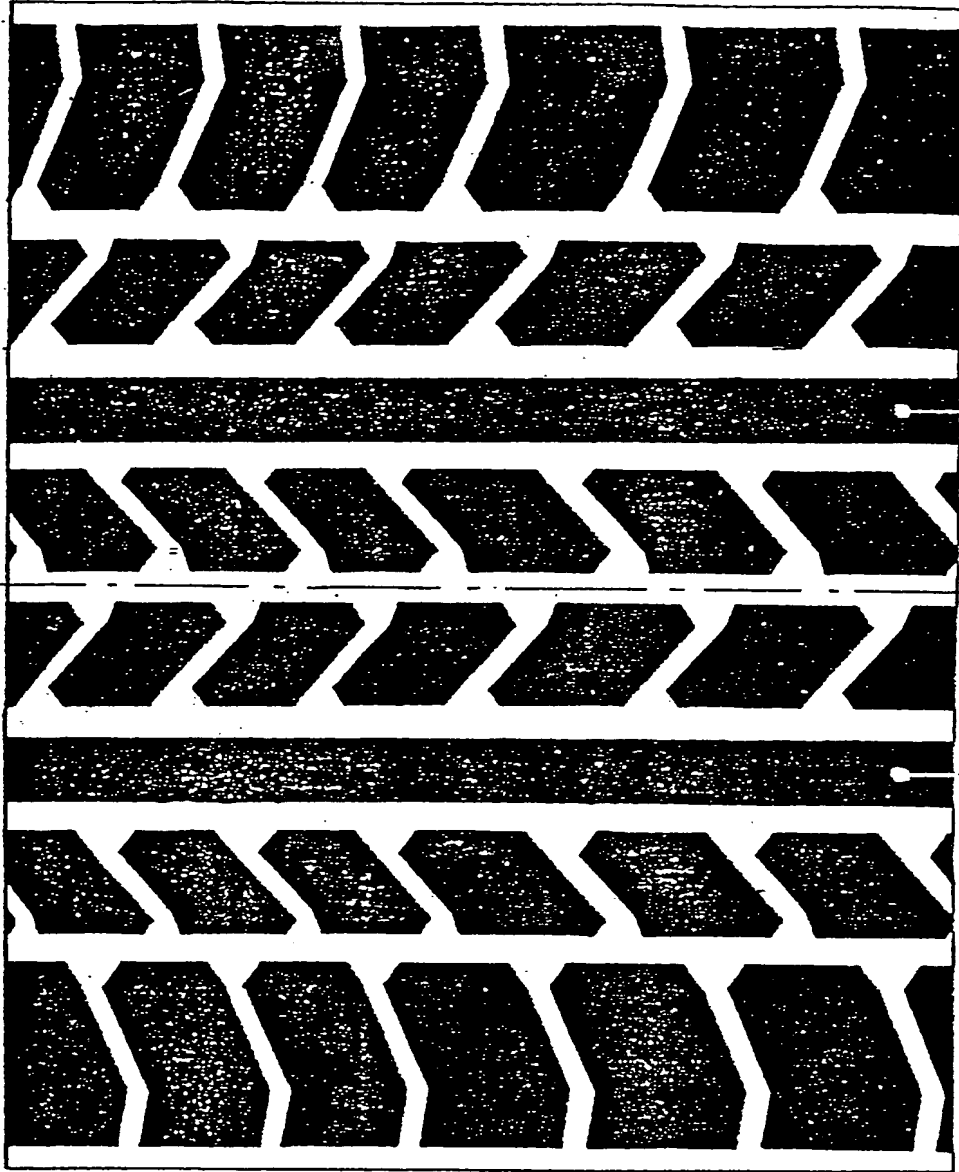


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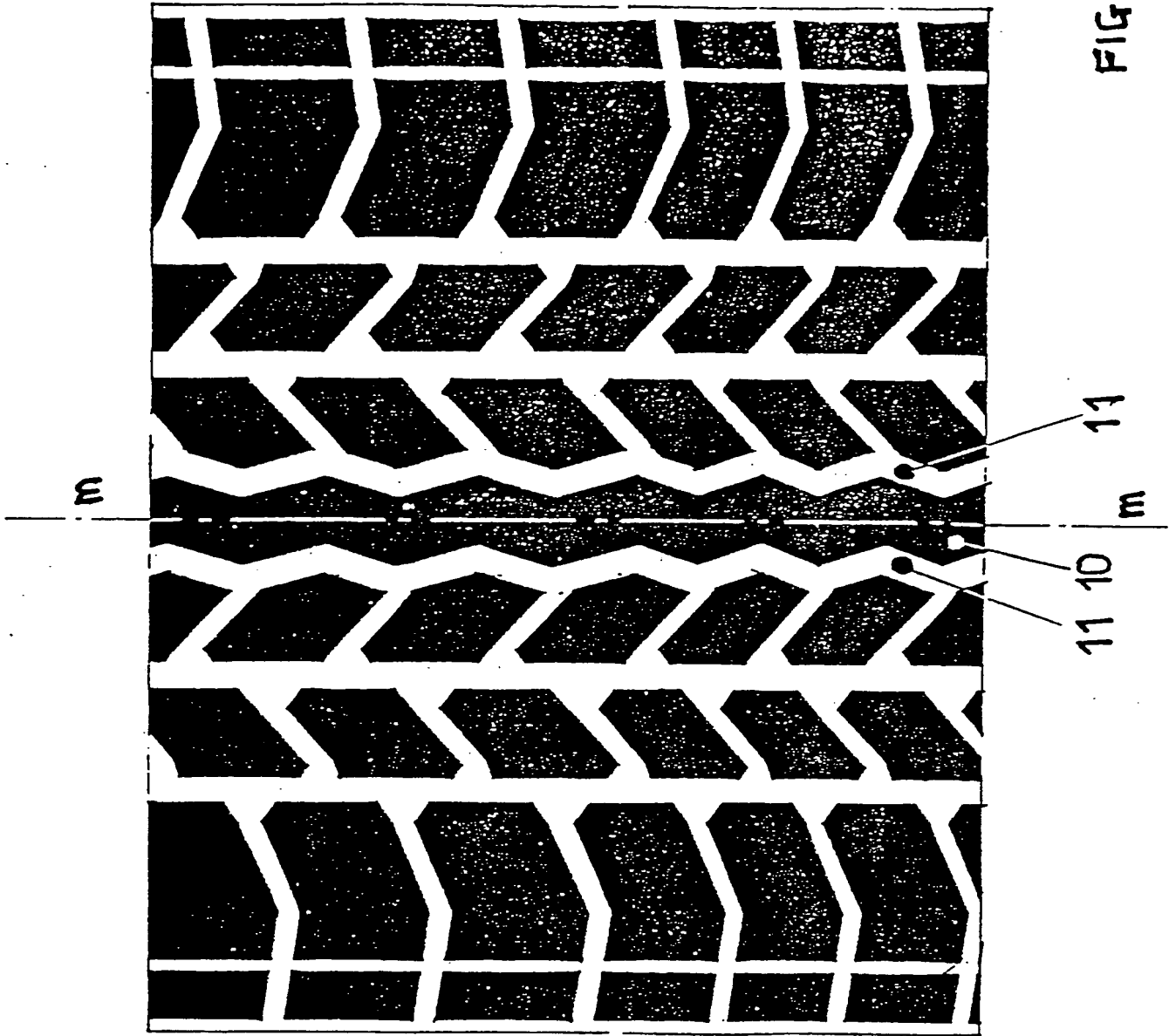
FIG 4



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FIG 5



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FIG 6

